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Life cycle of the tapeworm *Pseudodiorchis prolifer*
(Villot, 1890) comb. nova (= *Pseudodiorchis*
multispinosa Żarnowski, 1955)

Cykl rozwojowy tasiemca *Pseudodiorchis prolifer* (Villot, 1890)
comb. nova (= *P. multispinosa* Żarnowski, 1955)

The present paper is one of the links of the elaborated by me problem of the biology and dynamic of the occurrence in the annual cycle of tapeworms from insectivorous micromammals in the Białowieża National Park.

In the course of studies on the life cycles of the tapeworms I conducted dissections of various species of *Arthropoda* and *Mollusca* (Kisielewska, 1958 a, b, 1959) searching natural invasion with larval forms of *Cestoda*. Among others in *Glomeris connexa* Latzel (*Myriapoda*) were found in the spring, summer and autumn 1957 and 1958 very characteristic larval forms, which after closer analysis proved to be identical to forms described as *Urocystis prolifer* Villot, 1890. Villot found the larvae described by him in *Glomeris conspersa* and *Glomeris limbata* (cited after Joyeux et Baer, 1936).

Morphogenesis of *Urocystis prolifer*
in the intermediate host

Among the enormous number of larvae occurring in the single host specimens the majority of them were forms completely developed, capable to further invasion. The stages reached in the development by the remaining part of the larvae were various, therefore it made it possible to reconstruct approximately the process of the formation of the cysts.

The earliest morphogenetic form among them had a character of a parenchymatous mass from which bud the anlagen of future single larval individuals bound with it by structures resembling by their shape the cercomeres (Fig. 1). Further development takes place either in combination with the maternal cellular mass, or after



Fig. 1. The young bound larvae of *P. prolifer* (Villot)

separating from it. The described form is, of course, really not the earliest originating after the invasion of the host. Joyeux (1922) too did not succeed to observe earlier forms. It should be supposed that the oncosphere after liberating itself from egg shells in the alimentary tract and after the penetration to the body cavity of the host rapidly grows and produces numerous scolices, every one of which gets transformed into the invasive larval form. This augmenting the numerosity of the parasites mode of development is a certain kind of recompence in, as will be shown later, that the mature forms of the described larval form possesses barely 1 — 2 mature uterine segments which contain according to Żarnowski (1957) 7 — 8, and according to my observations 14 eggs in each segment.

Further development of every one of the anlagen which bud off takes rather a course typical to *Hymenolepididae*. Therefore we are able to discern here: (a) the formation of the „lacuna primitiva”, (b) morphogenesis — formation of the body of the larva, collum and scolex, (c) scolicogenesis — formation of holdfast organs of the head that is suckers and imaginal crown of hooks, (d) invagination.

Description of larvae

Finally developed larvae found in *Glomeris connexa* Latz. are characterized principally by very small dimensions, what is also stressed by Joyeux. Larvae freshly invaginated have almost a spherical shape or are pear-like (Fig. 2 a) and measure 60 — 72 μ

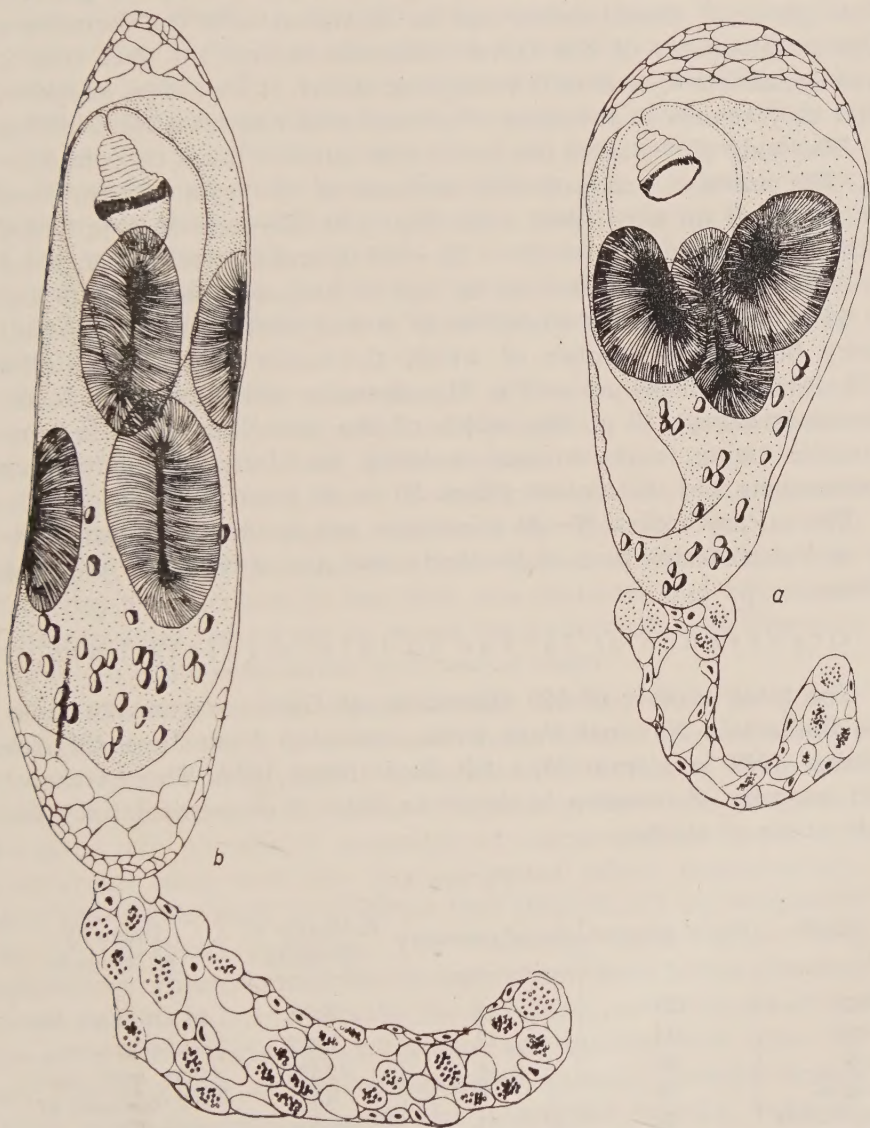


Fig. 2 a, b. The larvae of *P. prolifer* (Villot)

in width, 64 — 103 μ in length. Older cysts are decisively elongated and narrow; they measure 28 — 48 μ in width and 121 — 148 μ in length. In the posterior part there is a tail — the remnant of the connection with the maternal parenchymatous mass. Its width at the basis is circa 16 μ , its length, however, is very variable, what most likely is related to its disposition to break into fragments. This „pedicle” should rather not be identified with the cercomere. The development of the larvae indicates it and the fact that it was impossible to find in it embryonic hooks. It should be supposed that they remain in the mass of parenchyma non used for budding.

The body of the larva lies in the cyst but fills it not up completely. The anterior and posterior sections of the cyst remain free, or are filled up with loose cells (Fig. 2 b). The scolex is provided with 4 oval suckers (17 — 20 $\times$ 32 — 36 μ) and a rostellum enclosed by a rostellar sheath and by its size it surpasses the suckers (up to 44 μ in length). The rostellum is armed with a crown of small forked hooks, the number of which fluctuates within the limits 120 — 140, their seize 5 — 6 μ . The diameter of the crown of hooks measures always 20 μ . The width of the rostellum alone is very variable owing to its unusual mobility manifested in continuous contractions and distensions (from 20 to 48 μ in width).

The calcary bodies, 16—34 in number, are accumulated exclusively in the posterior part of the body and are of various, irregular shape.

Occurrence of larvae in intermediate host

The total number of 525 dissections of *Glomeris connexa* from the Białowieża National Park were conducted from June till November 1957 and from May till September, 1958. The extensity and intensity of invasion is shown in Table I prepared jointly for both series of studies.

Table I

Month	No. of sections	No. of invaded	Extensity of invasion	Intensity of invasion
May	135	11	8.1%	In all cases the invasion was very high (several thousand of larvae)
June	214	12	5.6%	
July	33	4	12.1%	
August	55	5	9.1%	
September	58	11	18.9%	
November	30	4	13.3%	

Adult form and definite host

Villot describing in 1890 the larval form named by him *Urocystis prolifer* was not able to relate it to any of the known species of adult tapeworms. He supposed that the definite host could be mammals or birds of the Alpine fauna. Joyeux (1922) studying the larvae described by Villot attempted to cause an invasion in white mice, hedge-hogs, moles and *Crocidula russulus* Herm. but without success. The author arrived therefore to the conclusion that either the investigations should be conducted along a different line (e. g. forest micromammals which are in closer contact with the myriapods of the genus *Glomeris*) or that it is a tapeworm in which only the larval form is provided with hooks on the scolex and the adult forms are deprived of the hooks secondarily. Thus the problem of linking the larvae *Urocystis prolifer* Villot with an adult form of a species of a tapeworm has not been definitely solved.

In the course of my observations of live tapeworms collected from dissections of insectivorous micromammals of the Białowieża National Park I noticed in *Sorex araneus araneus* L. extremely small and in great numerosity occurring forms which I diagnosed as belonging to the species described by Żarnowski (1955) under the name *Pseudodiorchis multispinosa* Żarn. Their numerosity of occurrence in one host, the structure and equipment of the rostellum induce me to accept the hypothesis that *Urocystis prolifer* Villot constitutes their larval form.

This supposition was experimentally corroborated. In August and September 1958 to five common shrew (*Sorex araneus araneus* L.) were administered slightly macerated myriapods in which previously the invasion with larvae *Urocystis prolifer* was diagnosed. The artificially invaded 5 specimens of common shrew were kept in vivarium since over one year, a period which fundamentally offers reasonable basis to presume that they should be completely free of intestinal parasites. The following facts support this presumption. Dissections of the common shrew kept in the vivarium proved that up to 2 — 3 months the intestinal parasitofauna of the animals did not differ quantitatively and qualitatively from the basic parasitofauna of the corresponding animals dissected immediately after the catch. During the subsequent months, however, in the animals kept in the vivarium a change takes place; certain

short-living species of parasites disappear, and the numerosity of the remaining ones also decreases. Practically after 5 — 6 months the common shrew kept in the vivarium are deprived of worms, in their alimentary tract are found only sporadically single individuals of the most long-living species as, e. g., *Choanotaenia crassicolex* (Linstow, 1890). The common shrew kept in the vivarium cannot get again invaded because they are fed exclusively with minced veal.

Out of 5 common shrews fed with invaded myriapods, one died on the sixth day following the invasion. The dissection of its alimentary tract showed the presence of over 600 tiny, sexually immature tapeworms of the same scolex as the scolex of the larvae *Urocystis prolifer*. The four remaining common shrew were killed on the 14th, 18th and 21st day. All four animals were invaded with great numbers of the tapeworm *Pseudodiorchis multispinosa* Żarnowski, 1955.

It can be regarded as proved that in the Białowieża National Park the life cycle of *Pseudodiorchis multispinosa* includes *Sorex araneus araneus* L. as the definite host, and the myriapod *Glomeris connexa* Latzel as the intermediate host. Simultaneously it was proved that the described by Villot form *Urocystis prolifer* Villot is the larval form of *Pseudodiorchis multispinosa* Żarnowski. Besides, this species is for the Białowieża National Park reported for the first time.

In accordance with the rules of nomenclature both the larval form and the adult form of the described tapeworm should be named *Pseudodiorchis prolifer* (Villot, 1890) comb. nova.

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STRESZCZENIE

W toku badań nad cyklami rozwojowymi tasiemców drobnych ssaków owadożernych w Białowieskim Parku Narodowym przeprowadzono sekcje różnych gatunków stawonogów i ślimaków lądowych w poszukiwaniu naturalnego zarażenia larwami tych tasiemców. Między innymi u *Glomeris connexa* Latzel (*Myriapoda*) w okresie wiosny, lata i jesieni 1957 i 1958 roku znajdowano postacie larwalne, które okazały się identyczne z formami opisanymi przez Villota (1890) jako *Urocystis prolifer* Villot.

Larwy te, występujące u pojedynczych osobników żywicielskich w ogromnej liczebności, odznaczały się tak różnorodnym stanem zaawansowania w rozwoju, że pozwoliło to zrekonstruować w przybliżeniu kształtowanie się ich cyst oraz dokładnie opisać ich budowę.

Wykonano łącznie 525 sekcji *Glomeris connexa*. Ekstensywność i intensywność zarażenia ilustruje tabela I.

Autorce udało się stwierdzić na drodze morfologicznej analizy porównawczej, a następnie przez zarażenia eksperymentalne, że *Urocystis prolifer* Villot, znajdowana w wijach *Glomeris connexa* Latzel na terenie B.P.N., jest postacią larwalną tasiemca opisanego przez Żarnowskiego (1955) pod nazwą *Pseudodiorchis multispinosa*, a występującego u ryjówki aksamitnej (*Sorex araneus araneus* L.). Tasiemiec ten występuje u tych ssaków również na terenie B.P.N.

Według przepisów nomenklatorycznych larwa *Urocystis prolifer* Villot oraz postać dorosła *Pseudodiorchis multispinosa* Żarnowski, jako różne postacie rozwojowe tego samego gatunku, otrzymają wspólną nazwę *Pseudodiorchis prolifer* (Villot, 1890) comb. nova.